THE TEST AND EVALUATION OF EO SENSORS

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AGENDA

- **BACKGROUND**
- **SPECIFICATION vs. REALITY**
- **FACTORS AFFECTING T&E**
- **DEVELOPMENT TEST AND EVALUATION**
- **FUTURE TRENDS**
- **QUESTIONS**

BACKGROUND

WHAT IS SYSTEMS ENGINEERING?

- … Focuses on methods to solve problems, not the solution of the problem….
- … Specifications and performance metrics ……..
- …. Optimization methods in presence of constraints… .
- Modeling and Simulation

APPROACH

WHAT THE WARFIGHTER WANTS/NEEDS

SYSTEMS ENGINEERING

WHAT THE WARFIGHTER GETS

SPECIFICATION vs. REALITY

- **YARDSTICK OF PERFORMANCE DURING DT**
- **WHAT IS NEEDED vs. WHAT IS EXPECTED**
- **DT vs. OT**
  + Combined T&E
- **REQUIREMENTS "CREEP"**
  + Technology insertion/Spiral Development
- **PERFORMANCE BASED SPECIFICATION**

FACTORS AFFECTING T&E

- **Rules of Engagement**
  + Visual Conformation of Target
  + Higher resolution Sensors (Radar and EO)
  + Laser Designation
  + Real Time Imagery

- **VEHICLE INTEGRATION**
  + Treat System Under Test (SUT) as complete system: Front end – pilot
  + The aircraft/platform isn't the lab
  + Pilot to Vehicle Interfaces

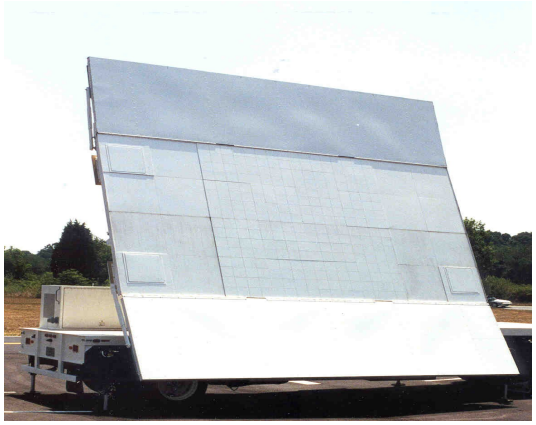
TESTERS DRIVEN TO DEVELOP TESTS AND PROCEDURES TO HANDLE TECH DEVELOPMENTS

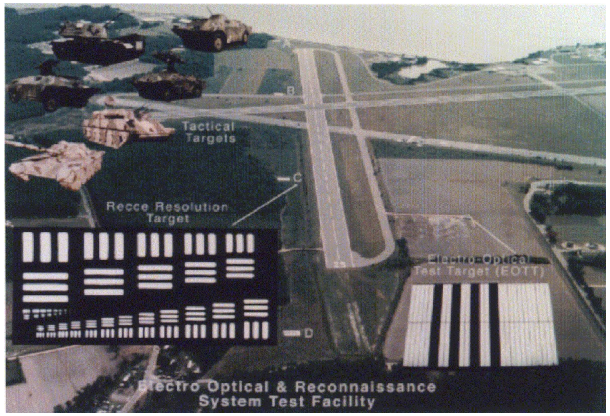
DEVELOPMENT TEST AND EVALUATION

- **CONSTRAINTS**
  - + LAB vs. Hangar
  - + Location of Equipment: Optical Bench vs. who knows where
  - + Variability of EO Sensors
    - * FOV's, Apertures, Scan Patterns, Lasers, etc.
  - + Test Equipment is never cheap or easy to maintain

- **FLIGHT vs. GROUND**
  - + Important to exercise SUT under loads
    - * Hard to impossible to simulate A/C vibration and acoustics
  - + Can't request weather and environmental conditions
  - + Human in the loop
  - + Sophisticated Target Boards

EO T&E EQUIPMENT





MODELING AND SIMULATION

- **Move towards modeling based acquisition**
- **Integral part of T&E process**
  - + Should not replace flight test
    - * Reduce and refine flight tests
- **Pro's and Con's for DT**
- **Sometimes not as cheap as presented**
  - + Cost to develop, maintain and upgrade

MODELING AND SIMULATION

ADVANTAGES	DISADVATAGES
Allows 1000's of data runs	Usually not stochastic (Random inputs)
Early diagnostic tool for design decisions	Expensive to develop
Ability to test edge of envelope	Only as good as data in
Cheaper than Flight Test	Can't replicate all variables of platform
Provides "What if's?"	Verification, Validation & Accreditation (VV&A)
Can allow inclusion of other sensors to test integration	Accuracy/fidelity cost and time driven
Provides input for Fleet battlefield Experimentation—Allows insight into the "big picture" overview for operational implementation	Constant upgrades/maintenance

MODELING AND SIMULATION

HARDWARE IN THE LOOP

- **DIGITAL INJECTION**
  - + Repeatable High Clutter Environments
  - + Edge of Envelope Excursions
  - + GIGO
  - + Not end-end
  - + SUT must be duped into flight mode (AoA, INS, Alt, Airspeed, etc)
  - + Access points not always accessible

- **SCENE PROJECTION**
  - + Project actual EO signals directly into optics
  - + Assume digital model can drive projection equipment
  - + Quick update rates over wide dynamic ranges
  - + Collimated images into a wide range of FOV’s
  - + Expensive to build/develop

MODELING AND SIMULATION

BEST APPROACH

- **Combination of Digital Injection, Scene Projection then Flight Test**
- **No one “Silver Bullet”**
- **Utilize all tools in the inventory**
- **Limits regression testing**

MODELING AND SIMULATION

VERIFICATION, VALIDATION AND ACCREDIDATION

- **Convince T&E Engineer models are accurate and representative**
  + Must answer more questions than it raises
- **Only as good as data in**
  + Sometimes too expensive to collect data, and pursue VV&A
    (Spend $20M to get the $100 answer)
- **Who funds the effort**
- **Budget Time and $$ into program for “tweaks and upgrades”**
  + Collect real data to verify model (within error bars)
- **Get OT buy in– They need assurance that model reflects real world**
  + No “build it and they will come”

FUTURE TRENDS

- **Real-Time Tactical Imagery**
- **Active vs. Passive Imaging**
- **Multiple Sensor Fusion**
- **Information Dissemination**
  + NCW

QUESTI0NS/COMMENTS

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